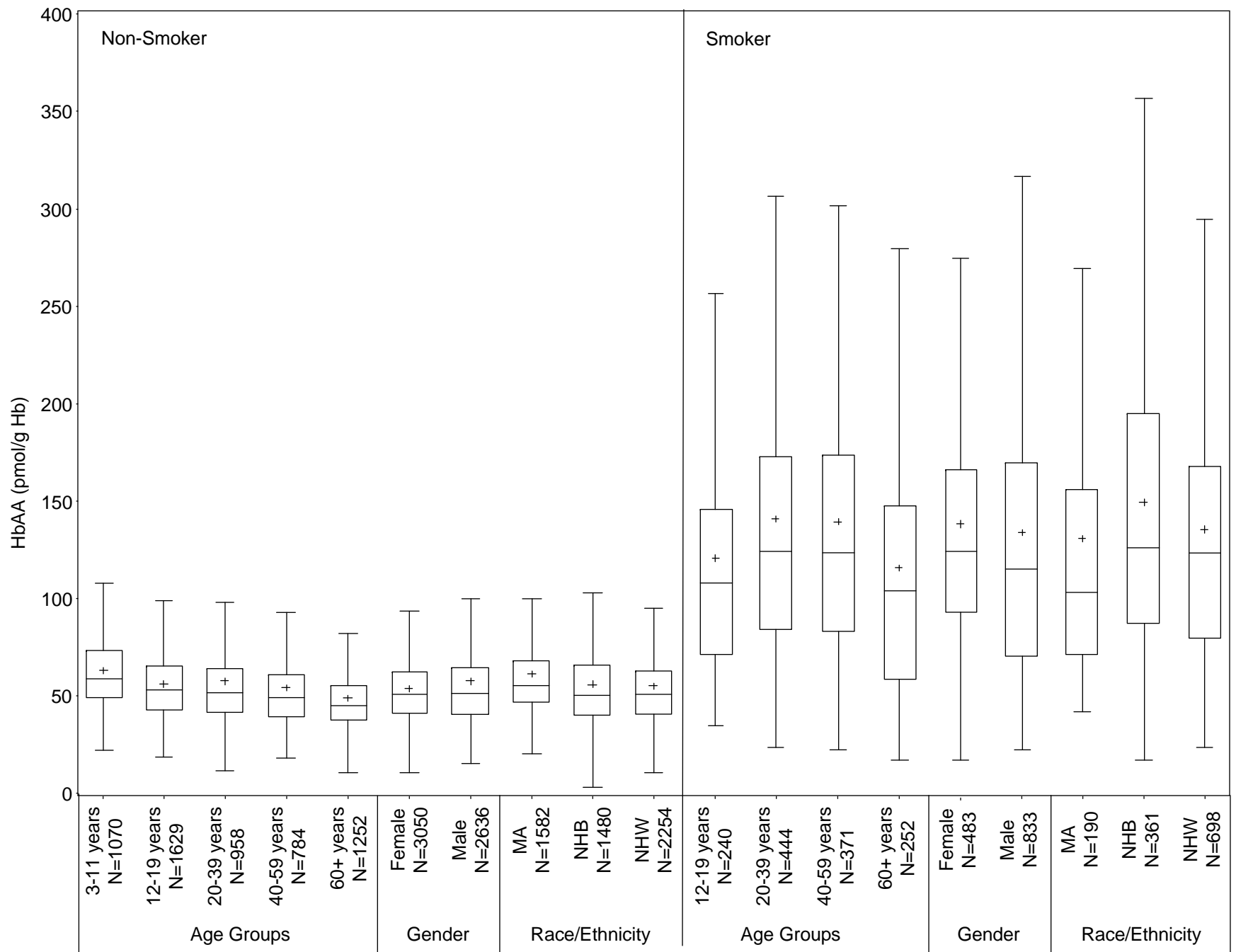


# Exposure of the U.S. Population to Acrylamide in the National Health and Nutrition Examination Survey 2003–2004

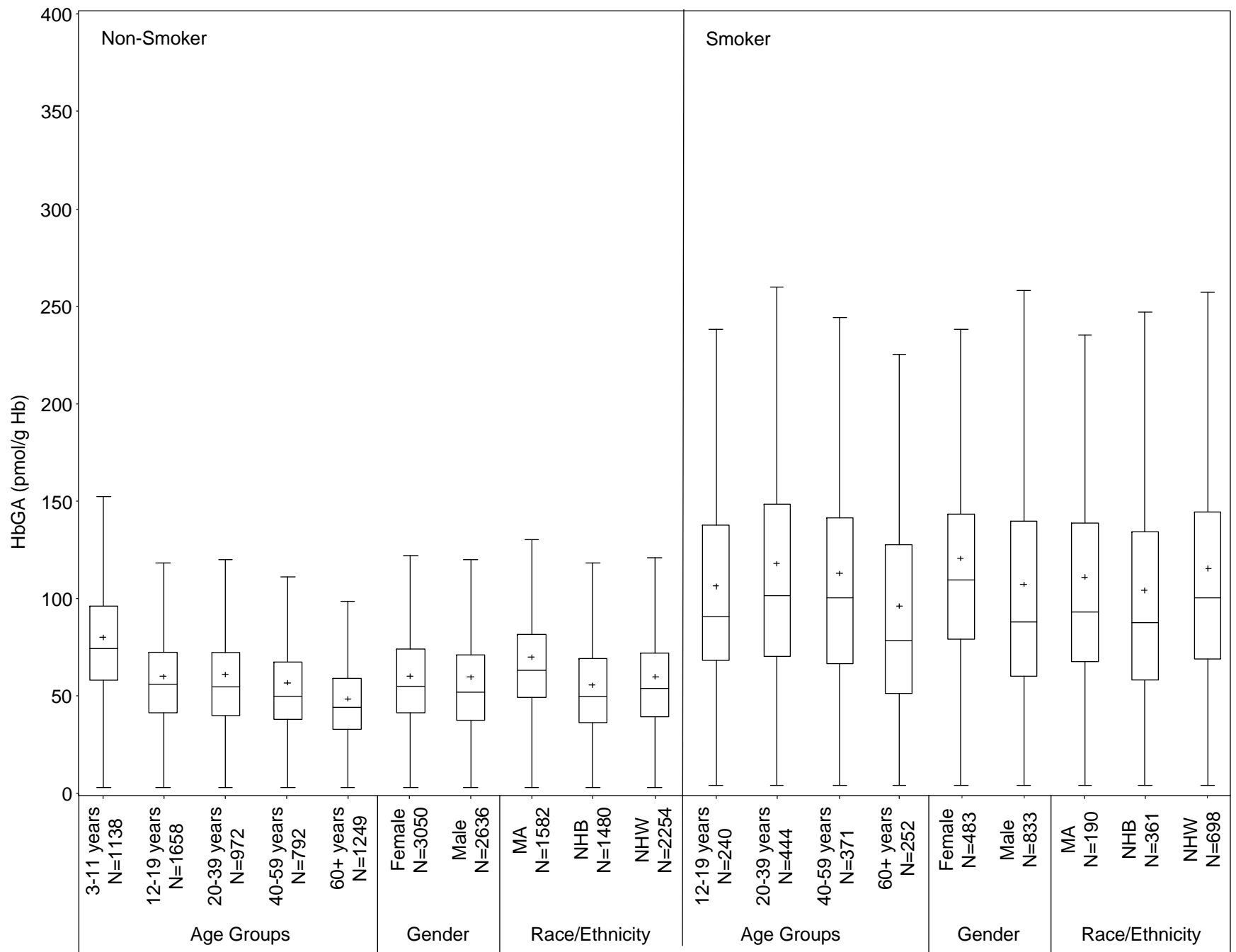
**Figure 1:** Box-Whisker plot hemoglobin adducts of acrylamide (HbAA) level in nonsmokers by age, gender and race/ethnicity (NHW: non-Hispanic white, NHB: non-Hispanic black, MA: Mexican-American). Plot represents the minimum and maximum levels, 25th and 75th percentile, median and mean (cross).

**Figure 2:** Box-Whisker plot hemoglobin adducts of acrylamide (HbGA) levels in nonsmokers by age, gender and race/ethnicity (NHW: non-Hispanic white, NHB: non-Hispanic black, MA: Mexican-American). Plot represents the minimum and maximum levels, 25th and 75th percentile, median and mean (cross).

**Figure 1:** Box-Whisker plot hemoglobin adducts of acrylamide (HbAA)



**Figure 2: Box-Whisker plot hemoglobin adducts of acrylamide (HbGA)**



## Supplemental Material, Model Information

Multiple regression analysis of the log-transformed HbAA and HbGA levels in nonsmokers with the categorical variables of age group, gender, and race/ethnicity and the continuous variables of BSA and logarithmic cotinine levels showed significant main effects for all variables except gender ( $p = 0.057$ ) in the HbAA model and except for BSA ( $p = 0.7095$ ) in the HbGA model. Gender was retained in the final model for HbAA because it acted as a confounder, while BSA was removed from the final model for HbGA. For the HbGA/HbAA ratio, several interactions were statistically significant (BSA by age:  $p < 0.0001$ , BSA by gender:  $p < 0.0001$ , race/ethnicity by cotinine:  $p = 0.0055$ ).

For the regression analyses in smokers, the covariate age had to be modeled as a continuous variable due to the smaller sample size of smokers and a significant interaction between age and race-ethnicity for the HbAA model ( $p = 0.0003$ ), the HbGA model ( $p < 0.0001$ ), and the HbGA/HbAA ratio model ( $p = 0.0141$ ). Other statistically significant interactions for HbAA were as follows: BSA by cotinine ( $p < 0.0001$ ), gender by race/ethnicity ( $p = 0.0268$ ), and gender by BSA ( $p = 0.0386$ ). For HbGA, there were significant main effects for all variables except for BSA ( $p = 0.5990$ ), which was removed from the final model. For the HbGA/HbAA ratio, two additional interactions were statistically significant (age by BSA:  $p < 0.0001$  and gender by cotinine:  $p < 0.0001$ ).

**Supplemental Material, Table 1:** Selected percentiles (95%CI) of HbAA, HbGA in pmol/g Hb, and the HbGA/HbAA ratio in the nonsmoking U.S. population by gender, age, and race/ethnicity.

Analyte	Parameter	Group	N	P10	P25	P50	P75	P90	P95
HbAA	All		5686	32.1	39.7	49.7	62.0	77.0	89.6
	(95%CI)			(30.9–33.4)	(38.3–41.2)	(48.1–51.3)	(59.7–64.4)	(74.3–81.1)	(85.4–96)
	Sex	Female	3050	32.7	39.8	49.5	61.1	75.7	85.9
		(95%CI)		(31.3–34.1)	(38.9–40.6)	(48.3–50.9)	(59.1–63.2)	(72.2–80)	(82.2–91.1)
		Male	2636	31.5	39.5	49.9	63.1	80.1	96.2
		(95%CI)		(29.3–33.7)	(37.2–42.1)	(47.6–52.2)	(60.6–66.1)	(75.9–83.7)	(87.7–104)
	Age Group	3–11	1070	39.5	47.9	57.3	71.6	87.5	101
		(95%CI)		(38.5–41.3)	(45.5–49.5)	(55.2–59.9)	(67.4–77.8)	(84.6–91.4)	(91.4–108)
		12–19	1629	34.9	41.8	51.8	64.0	77.9	89.3
		(95%CI)		(32.9–36.5)	(40.4–43.7)	(50.0–53.7)	(60.6–67)	(73.3–82.8)	(82.4–96.6)
		20–39	951	32.4	40.6	50.7	62.9	76.8	91.1
		(95%CI)		(30.4–34.8)	(38.2–42.9)	(48.7–53.1)	(59.9–66.1)	(72.8–82.8)	(82.8–106)

HbGA	Race/ Ethnicity	40–59	784	31.6	38.3	47.7	59.9	74.4	88
		(95%CI)		(29.3–33.3)	(36–40.6)	(44.8–50.2)	(57–63.9)	(69.7–82.2)	(76.2–110)
		60+	1252	28.7	36.4	43.9	54.5	67.5	79.3
		(95%CI)		(27.4–30.8)	(34.9–37.5)	(42.5–45.6)	(52.4–58.1)	(63.0–72)	(73.3–83.7)
		NHW	2254	32.6	39.6	49.7	61.5	76.6	87.7
		(95%CI)		(31.2–33.9)	(38.2–41.3)	(48.1–51.4)	(59.3–63.9)	(73.5–80.9)	(84.7–94.2)
		NHB	1480	30.8	39.5	49.4	64.9	81.6	100
		(95%CI)		(29.2–32.1)	(37.5–41.4)	(46.5–53.4)	(59.6–70)	(74–93.7)	(85.6–110)
		MA	1582	39.2	45.7	54.6	67	81.9	96.2
		(95%CI)		(37.5–41.3)	(43.4–47.6)	(51.5–57.5)	(63.1–71.5)	(77.6–87.6)	(87.6–104)
HbGA	All		5809	28.7	39.3	53.5	72.4	94.2	114
	(95%CI)			(26.9–30.5)	(37.9–40.8)	(51.4–55.6)	(69.4–75.2)	(89.5–98.9)	(107–123)
	Sex	Female	3111	29.4	41.5	54.8	73.7	92.1	113
	(95%CI)			(27.4–32.1)	(39.5–43.6)	(52.4–57.7)	(70.3–77.2)	(88.2–96.7)	(101–124)
		Male	2698	27.5	37.4	51.5	70.4	96.9	115

	(95%CI)		(26.3–29.7)	(36.3–38.9)	(49.6–54.1)	(67.4–73.5)	(91.1–102)	(110–121)
Age Group	3–11	1138	47.7	57.8	74.1	95.6	121	139
(years)	(95%CI)		(44.2–49.4)	(54.4–61.4)	(70.5–77.3)	(91.5–99.3)	(116–125)	(125–148)
	12–19	1658	29.8	41.3	55.8	72.3	93.5	115
	(95%CI)		(26.2–33.2)	(38.5–43.9)	(52.9–58.4)	(68.6–75.8)	(80.2–112)	(ND)
	20–39	972	31.2	40.0	54.3	71.9	92.9	108
	(95%CI)		(27.5–33.6)	(37.5–43.1)	(50.2–57.9)	(66.9–77.6)	(85.9–97.6)	(99.4–124)
	40–59	792	27.8	37.9	49.7	67.0	84.9	101
	(95%CI)		(25–31.2)	(36–40.4)	(47–53.2)	(63.5–71.2)	(79.7–88.8)	(87.5–129)
	60+	1249	23.7	32.6	44.0	59.1	77.4	92.0
	(95%CI)		(21.2–25.5)	(30.4–34.2)	(42.3–46.1)	(54.8–63.4)	(72.6–80.7)	(85.8–98)
Race/	NHW		29.0	39.5	53.7	72.2	92.9	113
Ethnicity	(95%CI)	2287	(27.4–30.6)	(37.9–41.2)	(51.2–56.2)	(68.4–75.4)	(88.3–97.8)	(103–124)
	NHB		25.2	36.4	49.8	69.4	92.9	108
	(95%CI)	1533	(21.3–28.5)	(34.9–37.7)	(46.2–53.3)	(64.2 - 74.1)	(86.2–97.6)	(101–116)

		MA		39.3	49.2	63.1	81.6	108	125
		(95%CI)	1622	(36.4–40.5)	(47.2–50.5)	(58.7–67.7)	(77–87.5)	(97.2–118)	(109–158)
HbGA/	All		5464	0.70	0.87	1.06	1.29	1.52	1.71
HbAA	(95%CI)			(0.66–0.74)	(0.84–0.89)	(1.02–1.09)	(1.24–1.33)	(1.47–1.58)	(1.60–1.85)
Ratio	Sex	Female	2931	0.72	0.90	1.10	1.33	1.55	1.78
		(95%CI)		(0.67–0.76)	(0.86–0.93)	(1.06–1.14)	(1.29–1.38)	(1.49–1.64)	(1.63–1.98)
		Male(	2533	0.68	0.84	1.02	1.23	1.47	1.63
		95%CI)		(0.65–0.71)	(0.81–0.87)	(0.99–1.04)	(1.18–1.28)	(1.41–1.54)	(1.54–1.78)
		3–11	1030	0.91	1.07	1.28	1.48	1.70	1.98
		(95%CI)		(0.87–0.94)	(1.03–1.12)	(1.24–1.32)	(1.42–1.53)	(1.61–1.81)	(1.80–2.17)
		12–19	1563	0.70	0.85	1.03	1.26	1.48	1.75
		(95%CI)		(0.61–0.76)	(0.83–0.89)	(1.00–1.07)	(1.20–1.32)	(1.37–1.67)	(ND)
		20–39	919	0.70	0.87	1.05	1.26	1.51	1.65
		(95%CI)		(0.67–0.74)	(0.83–0.90)	(1.01–1.10)	(1.19–1.33)	(1.43–1.59)	(1.55–1.84)
		40–59	753						
				0.69	0.86	1.03	1.23	1.48	1.65

	(95%CI)		(0.64–0.74)	(0.81–0.91)	(0.99–1.08)	(1.18–1.32)	(1.39–1.58)	(1.52–1.80)
	60+	1199	0.64	0.80	0.98	1.19	1.42	1.63
	(95%CI)		(0.57–0.68)	(0.77–0.82)	(0.95–1.01)	(1.13–1.25)	(1.34–1.52)	(1.48–1.78)
Race/	NHW	2172	0.70	0.87	1.06	1.28	1.50	1.68
Ethnicity	(95%CI)		(0.67–0.74)	(0.84–0.90)	(1.02–1.10)	(1.23–1.34)	(1.45–1.56)	(1.56–1.85)
	NHB	1405	0.63	0.79	0.97	1.19	1.50	1.69
	(95%CI)		(0.54–0.70)	(0.74–0.83)	(0.93–1.01)	(1.13–1.26)	(1.35–1.62)	(1.51–1.95)
	MA	1533	0.81	0.95	1.12	1.34	1.58	1.76
	(95%CI)		(0.76–0.85)	(0.91–0.99)	(1.05–1.20)	(1.26–1.45)	(1.44–1.78)	(ND)

ND: Not determined because sample size for survey design effect was less than 30

**Supplemental Material, Table 2:** Selected percentiles (95%CI) of HbAA, HbGA in pmol/g Hb, and the HbGA/HbAA ratio in the smoking U.S. population by gender, age, and race/ethnicity.

Analyte	Parameter	Group	N	P10	P25	P50	P75	P90	P95
HbAA	ALL			50.7	76.8	117	164	230	277
	(95%CI)		1316	(45.5–58.4)	(68.1–85.2)	(108–127)	(149–191)	(210–258)	(242–323)
	SEX	Female		61.0	89.5	122	164	224	259
	(95%CI)		483	(57.3–65.7)	(78.1–101)	(113–136)	(149–189)	(187–259)	(ND)
		Male		46.8	67.4	113	165	237	287
	(95%CI)		833	(40.2–54.5)	(62.6–76.8)	(97.3–127)	(145–198)	(213–275)	(244–337)
	AGE GROUP	12–19		51.6	68.0	106	142	207	253
	(Years)	(95%CI)	240	(43.5–58.5)	(54.4–93.0)	(86.4–121)	(123–166)	(160–253)	(ND)
		20–39		57.7	80.5	122	170	237	287
	(95%CI)		444	(44.9–66.2)	(71.6–91.0)	(112–132)	(154–195)	(213–277)	(243–328)
		40–59		51.0	77.9	121	169	232	286
	(95%CI)		371	(43.9–61.1)	(65.4–90.8)	(108–134)	(146–202)	(217–259)	(248–340)
		60+		37.3	56.6	102	146	184	242
	(95%CI)		252	(32.5–41.7)	(49.5–72.0)	(91.2–116)	(133–165)	(163–242)	(ND)
	RACE	NHW		51.0	77.9	121	166	229	260
	/ETHNICITY	(95%CI)	698	(43.9–61.6)	(69.0–88.1)	(108–132)	(146–195)	(205–256)	(234–318)
		NHB		58.5	85.0	124	196	273	315
	(95%CI)		361	(49.9–66.4)	(74.1–88.9)	(104–150)	(160–218)	(222–305)	(ND)
		MA	190	52.2	69.2	101	154	223	336

HbGA	ALL	(95%CI)		(45.5–66.5)	(66.2–78.7)	(87.4–118)	(127–192)	(185–340)	(ND)
				43.7	65.5	97.2	141	235	235
	SEX	(95%CI)	1357	(40.5–48.2)	(60.7–68.7)	(88.2–106)	(128–156)	(207–267)	(207–267)
		Female		51.6	78.1	108	143	244	244
		(95%CI)	496	(45.5–58.6)	(67.6–89.8)	(101–116)	(130–162)	(208–278)	(208–278)
		Male		40.3	59.5	87.1	139	225	225
	AGE GROUP	(95%CI)	861	(36.6–44.6)	(56.9–64.1)	(79.4–95.2)	(122–155)	(201–285)	(201–285)
		12–19		52.2	67.5	89.9	137	200	200
	(Years)	(95%CI)	248	(43.2–56.2)	(54.1–85.4)	(79.1–113)	(99.4–162)	(ND)	(ND)
		20–39		49.1	69.2	99.8	147	250	250
		(95%CI)	464	(38.0–55.7)	(61.0–76.9)	(88.0–112)	(130–167)	(220–285)	(220–285)
		40–59		43.7	64.8	99.5	141	217	217
		(95%CI)	376	(40.8–48.2)	(59.1–70.1)	(89.6–111)	(126–159)	(197–278)	(197–278)
		60+		31.3	51.3	77.6	127	200	200
	RACE	(95%CI)	258	(26.4–37.1)	(44.1–60.2)	(67.2–94)	(107–141)	(ND)	(ND)
		NHW		47.1	68.1	99.8	144	235	235
	/ETHNICITY	(95%CI)	714	(40.5–53)	(63.2–75.8)	(89.6–112)	(130–163)	(210–278)	(210–278)
		NHB		39.1	57.3	87.3	134	241	241
		(95%CI)	381	(33.2–44.2)	(53.8–61.2)	(75.2–102)	(111–159)	(ND)	(ND)
		MA		43.3	66.7	92.3	139	250	250
		(95%CI)	194	(38.9–55.4)	(56.1–73.8)	(77.4–108)	(114–163)	(ND)	(ND)
GA/HbAA Ratio	ALL			0.55	0.68	0.83	1.03	1.22	1.39
	(95%CI)		1282	(0.51–0.58)	(0.66–0.70)	(0.81–0.87)	(1.0–1.06)	(1.16–1.31)	(1.29–1.53)

SEX	Female	466	0.60	1.33	0.88	1.06	1.27	1.42
	(95%CI)		(0.51–0.64)	(0.69–0.76)	(0.85–0.91)	(1.02–1.12)	(1.16–1.40)	(1.25–1.7)
	Male	816	0.54	0.66	0.81	1.01	1.21	1.37
	(95%CI)		(0.51–0.56)	(0.63–0.68)	(0.77–0.85)	(0.93–1.06)	(1.10–1.33)	(1.21–1.54)
AGE GROUP (Years)	12–19	234	0.63	0.75		1.10	1.29	1.39
	(95%CI)		(0.58–0.67)	(0.67–0.81)		(1.03–1.14)	(1.18–1.32)	(1.29–1.56)
	20–39	435		0.69	0.83 0.79–	1.03	1.22	1.40
	(95%CI)			(0.65–0.72)	0.87)	(0.99–1.07)	(1.14–1.31)	(1.23–1.62)
	40–59	362	0.51	0.66	0.81	1.03	1.20	1.38
	(95%CI)		(0.47–0.55)	(0.63–0.69)	(0.79–0.86)	(0.98–1.05)	(1.10–1.36)	(1.22–1.54)
	60+	243	0.51	0.68	0.83	1.04	1.26	1.34
	(95%CI)		(0.46–0.56)	(0.60–0.75)	(0.77–0.88)	(0.94–1.11)	(1.14–1.34)	(1.27–1.47)
RACE /ETHNICITY	NHW	682	0.58	0.70	0.84	1.05	1.23	1.40
	(95%CI)		(0.54–0.62)	(0.68–0.72)	(0.82–0.87)	(1.02–1.07)	(1.19–1.31)	(1.27–1.59)
	NHB	350	0.42	0.58	0.72	0.88	1.07	1.23
	(95%CI)		(0.37–0.47)	(0.51–0.61)	(0.65–0.77)	(0.82–0.95)	(1.00–1.15)	(1.07–1.38)
	MA	186	0.61	0.71	0.86	1.04	1.27	1.62
	(95%CI)		(0.51– 0.69)	(0.61–0.79)	(0.78–0.95)	(0.98–1.12)	(1.16–1.47)	(ND)

ND: Not determined because sample size for survey design effect was less than 30

**Supplemental Material, Table 3:** Covariate-adjusted geometric mean estimates (95% CI in parentheses) of HbGA/AA ratios in nonsmokers by age and cotinine stratified by race/ethnicity

Parameter	Percentile	NHW <sup>a</sup>	NHB <sup>b</sup>	MA <sup>c</sup>
Age (years)	5–9	1.70	1.52	1.71
	(95% CI)	(1.43–2.02)	(1.29–1.80)	(1.47–1.97)
	10–19	1.58	1.41	1.59
	(95% CI)	(1.37–1.82)	(1.23–1.61)	(1.40–1.80)
	20–29	1.36	1.20	1.38
	(95% CI)	(1.24–1.48)	(1.09–1.31)	(1.27–1.50)
	30–39	1.17	1.02	1.20
	(95% CI)	(1.12–1.22)	(0.95–1.11)	(1.14–1.27)
	40–49	1.00	0.87	1.04
	(95% CI)	(0.95–1.06)	(0.78–0.97)	(0.99–1.10)
	50–59	0.86	0.74	0.91
	(95% CI)	(0.78–0.96)	(0.63–0.87)	(0.83–0.99)
Cotinine	60+	0.74	0.63	0.79
	(95% CI)	(0.63–0.87)	(0.51–0.79)	(0.69–0.90)
	10 <sup>th</sup>	1.02	0.95	1.08
	(95% CI)	(0.96–1.08)	(0.84–1.07)	(1.00–1.17)
	50 <sup>th</sup>	1.03	0.90 <sup>d</sup>	1.06
	(95% CI)	(0.98–1.07)	(0.82–1.00)	(0.99–1.13)

90 <sup>th</sup>	1.04	0.83 <sup>e</sup>	1.02
(95% CI)	(1.00–1.09)	(0.76–0.90)	(0.94–1.10)

a: Non-hispanic white

b: Non-hispanic black

c: Mexican-American

d: Different from NHW (p<0.003), MA (p<0.004)

e: Different from NHW (p<0.0001), MA (p<0.0001)

**Supplemental Material, Table 4:** Covariate-adjusted geometric mean estimates (95% CI in parentheses) of HbGA/AA ratios in nonsmokers by gender stratified by percentiles of BSA.

Gender	25 <sup>th</sup> BSA	50 <sup>th</sup> BSA	75 <sup>th</sup> BSA
Male	1.04 (95%CI) (1.0–1.08)	0.97 (0.94–1.02)	0.92 (0.87–0.97)
Female	1.10 <sup>a</sup> (95%CI) (1.05–1.15)	1.07 <sup>b</sup> (1.03–1.13)	1.05 <sup>b</sup> (1.00–1.11)

a: Different from male (p<0.007)

b: Different from male (p<0.0001)

**Supplemental Material, Table 5:** Covariate-adjusted geometric mean estimates (95% CI) of HbAA in pmol/g Hb, and the HbGA/HbAA ratio in smokers BSA, race/ethnicity stratified and cotinine stratified by gender.

Parameter	Percentile	HbAA		HbGA/HbAA Ratio	
		Female	Male	Female	Male
BSA	25 <sup>th</sup>	70.9	75.7		
		(55.9–89.8)	(52.5–109)		
	50 <sup>th</sup>	95.9	95.4	(ND)	(ND)
		(86.5–106)	(77.1–118)		
	75 <sup>th</sup>	124	116		
		(113–135)	(101–133)		
Race/Ethnicity	NHW	123	112		
		(112–134)	(97.5–128)		
	NHB	123 <sup>b</sup>	131	(N/D)	(N/D)
		(106–144)	(114–149)		
	MA	119 <sup>b</sup>	129		
		(107–132)	(117–142)		
Cotinine	10 <sup>th</sup>			2.72 <sup>c</sup>	0.98
				(1.84–4.03)	(0.71–1.36)
	50 <sup>th</sup>			2.27 <sup>c</sup>	0.95
		(N/D)	(N/D)	(1.62–3.17)	(0.72–1.24)
	90 <sup>th</sup>			1.59 <sup>c</sup>	0.87
				(1.28–1.97)	(0.74–1.03)

ND: Not determined

a: Different from male ( $p < 0.0007$ )

b: Different from male NHB ( $p < 0.05$ ), MA ( $p < 0.02$ )

c: Different from male ( $p < 0.0001$ )

**Supplemental Material, Table 6:** Covariate-adjusted geometric mean estimates (95% CI) of HbAA, HbGA in pmol/g Hb, and the HbGA/HbAA ratio in smokers at specific ages stratified by race/ethnicity

Age, years	HbAA			HbGA			HbGA/HbAA Ratio		
	NHW	NHB	MA	NHW	NHB	MA	NHW	NHB	MA
20	124	166 <sup>a</sup>	123	106	118	108	1.13	0.95 <sup>b</sup>	1.15
(95% CI)	(111–140)	(145–190)	(104–145)	(95.7–118)	(102–136)	(87.2–135)	(1.01–1.27)	(0.83–1.10)	(0.99-1.32)
40	114	127	123	97.0	83.4 <sup>c</sup>	106	0.85	0.66 <sup>d</sup>	0.86
(95% CI)	(104–126)	(112–144)	(115–132)	(88.5–106)	(74.8–93.1)	(94.6–119)	(0.81–0.88)	(0.59–0.73)	(0.77-0.96)
60	105	96.5 <sup>e</sup>	123	88.5	59.1 <sup>f</sup>	104	0.63	0.45 <sup>f</sup>	0.64
(95% CI)	(96.5–115)	(81.3–114)	(102–149)	(80.1–97.8)	(51.1–68.5)	(84.5–126.9)	(0.55–0.73)	(0.36–0.56)	(0.52- 0.80)

a: Different from NHW (p<,0.0001), MA (p<0.005)

b Different from MA (p<0.002), NHW (p<0.0003)

c: Different from MA (p<0.003), NHW (p<0.0008)

d: Different from MA and NHW (p<0.0001)

e: Different from MA ( $p < 0.03$ )

f: Different from MA ( $p < 0.0001$ ), NHW ( $p < 0.0001$ )